SEQUENCE LISTING

<110> COSTA E SILVA, OSWALDO DA
VAN THIELEN, NOCHA
CHEN, ROUYING
ISHITANI, MANABU

<120> PHOSPHATASE STRESS-RELATED PROTEINS AND METHODS OF USE IN PLANTS

<130> 16313-0029

<140> 09/828,302
<141> 2001-04-06

<150> 60/196,001
<151> 2000-04-07

<160> 46

<170> PatentIn Ver. 2.1

<210> 1
<211> 656
<212> DNA
<213> Physcomitrella patens

<400> 1
gcacgaggag gacaagtctt ccgaacccag cttagagtac tggttcaagt gtgtagacct 60
ggattgtgac gggatgatta tgctacgagg agatgcaata tttttacgag gagcaacttc 120
atcggatgga gtgcatggct caggagcctg ttctttttga ggatatcgtt tgtcaaatga 180
cagatatgat cggacctgct aatgaaggac ggttgacact tcgggactta aagcgatgca 240
aattatctgg aaacttcttc aatatccttt ttaacctcaa caaattcgta gcttttgaga 300
ctcgtgatcc tttccttatt cgtcaggaga gagaggaccc gtcattaact gagtgggatc 360
gatttgcaca cattgagtac atccgacttt caatggaaga agatggcgag gatgcctcca 420
acggcagtgc tgaagtctgg gatgagcctg gttacgaagc ccccttttaa ccttctgttg 480
tccctcaaga tccaggcatt tgaatcatca gagcagagac ggacggcacg aagaattgcc 540
tgctggactt ttaagaaaac tggtctgtgc aacccttaa aggttgtcat ttatatcgta 600
aagcatcttg ttgagtgagc atcctgccta ggggaccctg tctctacttt aacatc 656

<210> 2
<211> 807
<212> DNA
<213> Physcomitrella patens

<400> 2
cggcacgagg aagcaggtta gaacctcaat gtggatcccg gagctagagg aaatgggagt 60
ttgctgacaa atagtatgtt gcttaatcca aagggcttgg caccacgtct atcatcaaac 120
ggaggacctg tgacacgagg catgccgtaa tcagccagga ctttgtattt cctcctggag 180
gcattccgtc acttcatctt ccctcggtag tagtttggag taacgaaacg acattagttg 240
cgagatgtag aagagtctac gcaaacgctc atgcatatca catcaactcc atatccaaca 300
acagcgattg tgagacatac atatctgcag atgatttgag aataaattta tggaaccttg 360
aagttagtga tcagagtttc aacattgttg acatcaaacc aacaaacatg gaagacctta 420
cagaggtgat aacgtctgca gagttccatc ctactcattg caatgtgtta gcatacagta 480
gcagcaaggg ctccattcga ctcattgata tgcgtcaatc agccttgtgt gatcgacact 540
ctaaagctgt ttgaggaaga actggagccc atcctggatc caagatcctt tttttcacag 600
aaatccatag cttcaatttc tgacattaag tttgcaagag gcgatcggta cattctccag 660

tcggggacta catggactct gaaactgtgg gatgtgaaca tggaatctgg tccctgtggc 720
acgtatttaa agtccacgag catttgcgac caaagcttcg tgatctctat gagaacgatt 780
cacctccgat aattgatgtg tccgggg 807

<210> 3
<211> 447
<212> DNA
<213> Physcomitrella patens

<400> 3
ggcacgagga agtatggaaa tgcgaatgtt tggaagtact tcacggatct gttcgactac 60
ctgcctctga cagctctcat tgagcacgag atttttgtc ttcatggtgg tctgtctcca 120
tcgctcgaca cattagatca catccgagcc ctagatcgta ttcaagaagt gccgcacgag 180
ggcccgatgt gtgatctact ctggtctgat ccagatgatc gttgtggatg gggtatttca 240
ccacgaggtg ccggttatac ttttggtcaa gatattgcag agcagttcaa tcataccaat 300
ggtctaagtt tggttgcacg tgctcaccag cttgtgatgg aaggatacaa ttggtgccag 360
gataaaaatg ttgtcacagt tttcagtgcc cccaattact gttaccgctg tgggaacatg 420
gccgccataa tgggagatag atgaaac 447

<210> 4
<211> 591
<212> DNA
<213> Physcomitrella patens

<400> 4
gcaccaggtt actgtggggc ctcgtccccc ggaagagcat gttagctggg gttagagagc 60
tagggcagtg agtgccgatc atttttgcgt cacgcgtatc gatttgcaag ggcgaagtgc 120
acaagaggga tgggaattta tctttgctct ccaaagactg acaagacatc cgaagatgat 180
gagaatgccg agttacgcta tggtttatca gccatgcaag ggtggcgcga tagcatggag 240
gatgcacaca aagctatctt aaacgttgat aagaacacgt caacatcaat atttggcatc 300
tttgatggtc acggaggtaa attggtggca aaattttgtg caaagcactt acaccaagag 360
gttctgaagt ctgaagcgta cgctaaaggt gacttaaaag caagtttgga atattccttt 420
ttacggatgg atgagatgat gaagggagca agtgggtgga aagagcttca aagtttggag 480
gaaacaagta gtcagcttga taaactcggt aatggaaata gctcctctaa tgcgagggag 540
gatgacgaaa gtgattattc ctatgctgtg ctaactgaaa gcaatgatag t 591

<210> 5
<211> 587
<212> DNA
<213> Physcomitrella patens

<220>
<221> modified_base
<222> (9)
<223> a, t, c, g, other or unknown

<220>
<221> modified_base
<222> (283)
<223> a, t, c, g, other or unknown

<400> 5
cggcacacng tttgtaccgc catttacaga aattgccacc caacatgggg gaatgtctag 60
tgaggttctt cagtcaagcc tttaagcaga ccgaggaggg gtttttggaa atcgtaaggg 120
attcatggct cacgaagccc cagattgctg ccgttggttc ctgttgcctg gtaggtgtgg 180

tgtgggagtg taagctgtac atcgccagcc tgggtgattc taaggctgtg ctcggtagat 240
tctctcgcaa tttgcaatca gtaattgcga cggagatatc ctnctgagca taacgccagt 300
gttgaggctg ttaggcagga cctgcaagct gcgcatcctg atgacccgcg cattgttgtg 360
ctgaggcacg gagtgtggcg tgtgaagggt ttgattcaag tctctcgatc cattggcgac 420
gtttatctga agaaggctga gttcaaccgt gagcctctaa tcggccggtt ccgcctgcca 480
gagccgctcc agagacccgt catgagcgcc gagccggaca tccgagtaat cgatctgacc 540
ccagatgtgg agttgtgatt ttgcatcaga tgggttgtgg gagcact 587

<210> 6
<211> 2559
<212> DNA
<213> Physcomitrella patens

<400> 6
atcccgggca tcgggaaaga cggtgtgtgt gtgtgtgtgt gtttgcttgc ttgcatgcat 60
tgtggggggt acccagatca tgcttcaggg aggtttggag tgcgcccaat ggagcccttg 120
acgttggccg tggcagatct ggaccccgat ctgcttcaac tccctgcgga tttcaccccc 180
tttgcttctc cttcatcgtc atcgcctgct tctgtgggag ttagcaacaa gcttggaggt 240
gtttgtaggt tgcacttgga ggagctttac gcgcaatgga tttcgctgcc cgacacgcag 300
cgtctggtta cgaatttgtt ggaagaagca aaaggaggag ctggacaccc aaatgttggc 360
ctatcacttt tgccaggtca tctatctgga gccgcaggaa gcactccccc gttgcctcct 420
cggagctctg gttcaccaat gtctcccagg tcgcctttca gcagacgtat gggaactagc 480
cacctcatgc gggactctcc gttgaagaaa agtagcgaac ctgtgcgaga gatcataccc 540
cagttctatt ttccgaatgg gcccccgcca tcgaaggata ccattgagtc gtgcatggct 600
cgcgtaaacc aaatattcgg agctcatcca gaaggtttac ctgcatcagc atttgcaacc 660
attactaagg atgtatgcaa actaccgtcc ttcttctcca tggctttatt caaaaagatt 720
gacatcaata atacaggctt ggttacaagg gacaagttcg tagaatactg ggtggaccaa 780
aacatgctgg ccatggacac tgcaactcgc gtcttcactg tgttgaagca acccgacaag 840
aattttctga gacaggaaga ttttaggccc gttttacgag aattgttgtt gacgcatcgc 900
ggtttggaat ttctccatga caccccggag tttcaagaca gatatgctga aactgtaata 960
tacagaatat tctaccatgt aaatagagct gggaatggtc ggctacaact tagagagtta 1020
aagcggagta atttaattgc tgctcttcag caagtggatg aagaggaaga catcaacaaa 1080
gtgttacgtt acttctcata tgaacatttt tatgtcatat attgcaagtt ctgggagctg 1140
gattcagatc acgatttttt aatagacaaa gatgatctcc ttcgatatgg aaatcatgct 1200
ctcacctacc gaatcgtaga gcgtatcttt tcccaggttc caagaaagtt caccagcaaa 1260
gtagctggaa agatgggtta tgaagacttc gtatggttta ttctttcaga agaggacaag 1320
tcttccgaac ccagcttaga gtactggttc aagtgtgtag acctggattg tgacgggatg 1380
attatactaa atgagatgca atatttttac gaggagcaac ttcatcggat ggagtgcatg 1440
gctcaggagc ctgttctttt tgaggatatc gtttgtcaaa tgacagatat gatcggacct 1500
gctaatgaag gacggttgac acttcgggac ttaaagcgat gcaaattatc tggaaacttc 1560
ttcaatatcc tttttaacct caacaaattc gtagcttttg agactcgtga tcctttcctt 1620
attcgtcagg agagagagga cccgtcatta actgagtggg atcgatttgc acacattgag 1680
tacatccgac tttcaatgga agaagatggc gaggatgcct ccaacggcag tgctgaagtc 1740
tgggatgagc ctggttacga agcccccttt taaccttctg ttgtccctca agatccaggc 1800
atttgaatca tcagagcaga gacggacggc acgaagaatt gcctgctgga cttttaagaa 1860
aactggtctg tgcaaccctt taaaggttgt ccatttatat cgtaaagcat cttgtttgag 1920
tgagcatcct gcctaggggg accctgtctc tactttaaaa tcagacaatg catgtgacat 1980
ttgtacagtt cacaaatggc agcatttatc tatttaggaa gtccttcaac attatatctt 2040
tcaggtctcc agctcgccat ttacgggtgc tactgtaact cgagtccttg tgcaagaatc 2100
atgaagaata ctgagcatgg cgacgtccaa aacttcgaga caacgtcaaa gaactacttg 2160
accggtctct caacaagttc tgttacttaa gtgcacagca ctggggtagc cctcttgctt 2220
tcaaaatcac tgtgtgtgac actgtagcta ctacttcagg gaaattgatg ttgggcattc 2280
taggccttct gagctttttt tgcaggtctt tttgatggtc tccgtcacgt tatttgttta 2340
ggaatgaagc agcctgccca ggatagtgat gtagacatgg tcccgtttct gatcttctca 2400
atcaggctta accatgcagt aattaagcag gtaggcacag tgtgctcaac acgtaatccc 2460
cttcccacac tagtcttctc tgtagactct ttatttcagc ttttgatccg gaacttaaag 2520
cttttgactg gttcagcccg aggctggtag cgttaacgc 2559

<210> 7
<211> 2005
<212> DNA
<213> Physcomitrella patens

<400> 7
atcccgggtg gtggtggcgg tgaagttatt acccgagagc ttcgacagct tcacgcatgt 60
ttgcgattgc acgcaaggac gcaactggct ccgtagttgt aatgaatgga ttcaccgcga 120
tgcaagcttc tcaacgagcc gttggaagct tcgtgtggtg gagtgtggaa actgccggag 180
ctccgtaacc atgcggggtt catggaagtg gtggctgcca attcggaggc ggatttcaat 240
gtggtagagt ttggacttag agttttgtag gaggaggggt tgaagtgtgg gccaagtgtt 300
ggggctcctg aaacagggga aaagaaaaag agacgacgac gccggagatt ggagattgag 360
gtgtgtgtgt gtgtgtttgt ggttagttta gcggtttgaa gtgatgatca gtggtgcaag 420
cggggcaccc gctggggccc cagttcccac tgctactggt tctgttgctg cgccattgcc 480
cgcgttggag tggaaattct cgcaggtttt cggcgagcgt gccatcggag aggaagtgca 540
agaagttgat attatctcgg ctattgagtt tgataagact ggagaacatt tggcgactgg 600
cgacagagga ggacgcgttg tacttttttga gagaacagat ggcaaagatc aaaggacacg 660
gagagagttg gaaagagctg attctgcggg gtccaggcat cctgaatatc gatactctac 720
cgagtttcaa agtcatgaac cagagtttga ttacttgaag agtttggaaa tagaggagaa 780
gatcaataaa attagatggt gtcagactgc caacgccgct cagttcttaa tttctacgaa 840
tgacaaaacc attaaattat ggaaggtgac tgaaaagaaa gtgaagcaag tcaagaacct 900
gaatgtggat cctggagcca gagggaatgg aaacccattg tcgaataaca tgatgctcaa 960
tccaaagggt tttgcaccac ggttgtcgat gaatggagtt gccgcgaacc gatctacgcc 1020
tgccatcagc cctgactttg tatttcctcc tggaggcatt ccgtctcttc atcttccctc 1080
ggtatggagt aacgagacgg cattagttgc gagatgtaga agagcctacg caaacgctca 1140
tgcatatcat atcaactcca tatctaacaa cagcgattgt gagacataca tctctgcaga 1200
tgatttgaga ataaatttat ggaatcttga agttagtgat cagagtttca atattgttga 1260
catcaaacca acaaacatgg aagaccttac agaggtgata acgtctgcag agttccatcc 1320
ttctcattgc aatgtgttag catacagtag cagcaagggc tctattcgac tcattgatat 1380
gcgtcaatca gccttgtgtg atcgacattc aaagctgttt gaggagactg agcatgctgg 1440
atcaagatcc ttttttacag aaatcatagc ttctatttct gatattaagt ttgcgagagg 1500
cggtcggtac attctgagtc gggactacat gactctgaaa ttgtgggatg tgaacatgga 1560
atcttccccct gtggccgtat ttaaagtcca cgagtatttg cgtccaaagc tttgtgatct 1620
ctatgagaac gactccatct tcgacaagtt tgaatgttgt cttagtgggg atggcatgcg 1680
tgtggcaact ggttcctaca gcaacttgtt ccgggtgttt ggggccgcta ccggaagtga 1740
ggaagcgtca accttggaag ctagcaagac tccaaacagg cgtatcgtga cacctccctc 1800
aaaagctgga agtcgactag ccaatcttgc tcgtggtcgg cgtgataacc gtcgaggtgg 1860
agaaagccca ggtatagatt tgaatggggg agtgcaagat ttcacatcaa agcttttgca 1920
cttagcatgg catccagcag cgaatgtgat cgctttcgcg ctagcgcgtt gctcgctgca 1980
tccaacagct tgtacatgtt aacgc 2005

<210> 8
<211> 1365
<212> DNA
<213> Physcomitrella patens

<400> 8
ggcgttaacg cgcggaggag agcggatcgg ttagggtttg gtgccagggg ggagggcaga 60
ggttgggaca atgccgtcat atgcagatgt agaccggcag atagagcagc tgtcggagtg 120
caagccgttg tcggagttgg aggtgaagaa cctatgtgat caagctcgga cgatcttggt 180
ggaggagtgg aacgtgcagc ccgtgaagtg tcctgtcacg gtttgcggtg acatccatgg 240
ccagtttcat gatctcatcg agcttttccg cataggaggc aaggcgcccg acacgaacta 300
cttgttcatg ggcgactatg tggatcgtgg atattattct gtcgagactg tgtcgctctt 360
agtggccctg aaggtgcggt atagggatag gatcacaatc ttgcgaggga accacgagag 420
caggcagatt acgcaagtat atggtttcta tgatgaatgc ctgcggaagt atggaaatgc 480

gaatgtttgg aagtacttca cggatctgtt cgactacctg cctctgacag ctctcattga 540
gcacgagatt ttttgtcttc atggtggtct gtctccatcg ctcgacacat tagatcacat 600
ccgagcccta gatcgtattc aagaagtgcc gcacgagggc ccgatgtgtg atctactctg 660
gtctgatcca gatgatcgtt gtggatgggg catttcacca cgaggtgccg gttatacttt 720
tggtcaagat attgcagagc agttcaatca taccaatggt ctaagtttgg ttgcacgtgc 780
tcaccagctt gtgatggaag gatacaattg gtgccaggat aaaaatgttg tcacagtttt 840
cagtgccccc aattactgtt accgctgtgg gaacatggcc gccataatgg agatagatga 900
aacaatgaat cggtcttttc ttcagttcga accagcaccg cggcaaagtg aaccagatgt 960
gacgcggaag actcctgatt actttctgta aacatggcct atacatggta ccttttactt 1020
actgaattgt tctgtatagt caccttccat ggaagcagtt tgcccctgaa tgaagatact 1080
ccctcatgat ctagtagtat gaagttatct tctttgaagt gtttgttccc ttttttagta 1140
cttgctcctc tgttcattca taaagttgcc ttcagaacaa ctgagatgtt gtgaatgtaa 1200
ctgcgacaag aggagcagtg tcaatggttg caagggttat agtgattagg gaaagaaggt 1260
agcacatgtt acttcaaatc gatcagagac ttctatggaa aagatgacga tggtggaaac 1320
aacgttcatc tccacaccta ctgtatatgg catgctcgag ctcgc 1365

<210> 9
<211> 1346
<212> DNA
<213> Physcomitrella patens

<400> 9
gcgatatcga tttgcaaggg cgaagtgcac aagagggatg ggaatttatc tttgctctcc 60
aaagactgac aagacatccg aagatgatga gaatgccgag ttacgctatg gtttatcagc 120
catgcaaggg tggcgcgata gcatggagga tgcacacaaa gctatcttaa acgttgataa 180
gaacacgtca acatcaatat ttggcatctt tgatggtcac ggaggtaaat tggtggcaaa 240
attttgtgca aagcacttac accaagaggt tctgaagtct gaagcgtacg ctaaaggtga 300
cttaaaagca agtttggaat attccttttt acggatggat gagatgatga agggagcaag 360
tgggtggaaa gagcttcaaa gtttggagga aacaagtagt cagcttgata aactcggtaa 420
tggaaatagc tcctctaatg cgagggagga tgacgaaagt gattattcct atgctgtgct 480
aactgaaagc aatgatagta acttggccac taaaaagcat aaatattcag atttccaggg 540
tcccatttat gggagtactg cagtggtggc tctgattcgt ggcaataaac tgttcgtcgc 600
aaacgctgga gactctcgct gcataatgtc tcgacgtggc gaggctgtaa atctctcgat 660
tgatcacaaa cccaacctag agcatgagag gaaaaggata gagagtgctg gaggcttcgt 720
ccatggtggt cgtgttaacg gtagtctaaa tcttacaaga gcaatagggg acatggaatt 780
caagggtcga cctgatttgc cacctgacaa gcaagtagtg acgtgctgtc ccgatgttgt 840
cgaagttgac cttggacccg gggatgaatt tatcgtgctg gcctgtgatg gaatatggga 900
tgttatgtct agtcaagctg tcgtggactt cgttaaatca agattaccta ccaccaaaac 960
tctatcatct ttgtgtgagg agatactgga ttactgcttg tccccaacca cccgccagca 1020
agaaggatgt gataacatga gcatcattat agtccaacca aagcaatcgg gagttgcagc 1080
atcttcttcc acagattgac gttgatgacc ttcgtcggac gctggagctc aaaactcatt 1140
gtggacttca acttctgagt tcaaagttcc ttgtagactt cttgtcatgt ccaacttcta 1200
cctaatttcg aatttcaaaa gacttaaata taaacctaga tataggctga tcataaaatt 1260
tcgggtcaaa ggcgttatgg tcttctattc aaatataagg tgaattaatg ctaaaactgg 1320
gagttgcctt ctgccttcga tatcgc 1346

<210> 10
<211> 1410
<212> DNA
<213> Physcomitrella patens

<400> 10
atcccgggcg tggaaggaga gggaatgtgg aggaaagagt ggagttatta tttgtcagtc 60
gaatgtacag gaagaagcga aaaggatatg gagtggaaat atgaagaagc tggttgaaga 120
aggacgtctg agagatggta gagtgggtaa tgaagatgtt gatggcatgt tggcgtccgg 180
tgcaaaaata cacgcacctg ggggaggaga atggagataa ccacgaccca ctgctgtggc 240

acaaagattt gggtgatcat gccgcaggac agttttctat tgccgcagtt caggcgaatg 300
ctatcttgga ggacatggtc caagtggaaa ctggaccgtt tggtaccttt gttggggtgt 360
acgatggcca tggtggcccg gaagcttctc gttacgtcaa tgacagtttg taccgccatt 420
tacagaaatt tgccacccaa catgggggaa tgtctagtga ggttcttcag caagccttta 480
agcagaccga ggaggggttt ttggaaatcg taagggattc atggctcacg aagccccaga 540
ttgctgccgt tggttcctgt tgcctggtag gtgtggtgtg ggagtgtaag ctgtacatcg 600
ccagcctggg tgattctaag gctgtgctcg gtagattctc tcgcaatttg caatcagtaa 660
ttgcgacgga gatatccact gagcataacg ccagtgttga ggctgttagg caggacctgc 720
aagctgcgca tcctgatgac ccgcgcattg ttgtgctgag gcacggagtg tggcgtgtga 780
agggtttgat tcaagtctct cgatccattg gcgacgttta tctgaagaag gctgagttca 840
accgtgagcc tctaatcggc cggttccgcc tgccagagcc gctccagaga cccgtcatga 900
gcgccgagcc ggacatccga gtaatcgatc tgaccccaga tgtggagttt gtgatttttg 960
catcagatgg gttgtgggag cacttgtcca accaagaggc tgtggatatt gttcacaaat 1020
acccgcgcgc tggcatcgcc aggcagctca ttcgatacgc tcttcatgaa gcggccaaga 1080
agcgagagat gcggtactcg gatctgaaga agatcgagcg tggtatccgg agacactttc 1140
atgacgacat cacagtggta gtcgtcttct tagatcataa tttggttagc aatggtagtg 1200
gtatctcgca tcacatttct gtgaaaggtg gagttgacaa accttcttga aaaggggtcg 1260
taggtactct ccatggtatc ttgcaggttt tgtcacatga aacttccccc tttcgcacga 1320
tggggtagaa gtgattgctc ctttgaagct acacctccct gcaacccaat cgtctgtcga 1380
acctgaagct agacacccac aggagcttgc 1410

<210> 11
<211> 572
<212> PRT
<213> Physcomitrella patens

<400> 11

```
Met His Cys Gly Gly Tyr Pro Asp His Ala Ser Gly Arg Phe Gly Val
  1               5                  10                  15

Arg Pro Met Glu Pro Leu Thr Leu Ala Val Ala Asp Leu Asp Pro Asp
             20                  25                  30

Leu Leu Gln Leu Pro Ala Asp Phe Thr Pro Phe Ala Ser Pro Ser Ser
         35                  40                  45

Ser Ser Pro Ala Ser Val Gly Val Ser Asn Lys Leu Gly Gly Val Cys
     50                  55                  60

Arg Leu His Leu Glu Glu Leu Tyr Ala Gln Trp Ile Ser Leu Pro Asp
 65                  70                  75                  80

Thr Gln Arg Leu Val Thr Asn Leu Leu Glu Glu Ala Lys Gly Gly Ala
                 85                  90                  95

Gly His Pro Asn Val Gly Leu Ser Leu Leu Pro Gly His Leu Ser Gly
            100                 105                 110

Ala Ala Gly Ser Thr Pro Pro Leu Pro Pro Arg Ser Ser Gly Ser Pro
        115                 120                 125

Met Ser Pro Arg Ser Pro Phe Ser Arg Arg Met Gly Thr Ser His Leu
    130                 135                 140

Met Arg Asp Ser Pro Leu Lys Lys Ser Ser Glu Pro Val Arg Glu Ile
145                 150                 155                 160
```

Ile Pro Gln Phe Tyr Phe Pro Asn Gly Pro Pro Pro Ser Lys Asp Thr
165 170 175

Ile Glu Ser Cys Met Ala Arg Val Asn Gln Ile Phe Gly Ala His Pro
180 185 190

Glu Gly Leu Pro Ala Ser Ala Phe Ala Thr Ile Thr Lys Asp Val Cys
195 200 205

Lys Leu Pro Ser Phe Phe Ser Met Ala Leu Phe Lys Lys Ile Asp Ile
210 215 220

Asn Asn Thr Gly Leu Val Thr Arg Asp Lys Phe Val Glu Tyr Trp Val
225 230 235 240

Asp Gln Asn Met Leu Ala Met Asp Thr Ala Thr Arg Val Phe Thr Val
245 250 255

Leu Lys Gln Pro Asp Lys Asn Phe Leu Arg Gln Glu Asp Phe Arg Pro
260 265 270

Val Leu Arg Glu Leu Leu Leu Thr His Arg Gly Leu Glu Phe Leu His
275 280 285

Asp Thr Pro Glu Phe Gln Asp Arg Tyr Ala Glu Thr Val Ile Tyr Arg
290 295 300

Ile Phe Tyr His Val Asn Arg Ala Gly Asn Gly Arg Leu Gln Leu Arg
305 310 315 320

Glu Leu Lys Arg Ser Asn Leu Ile Ala Ala Leu Gln Gln Val Asp Glu
325 330 335

Glu Glu Asp Ile Asn Lys Val Leu Arg Tyr Phe Ser Tyr Glu His Phe
340 345 350

Tyr Val Ile Tyr Cys Lys Phe Trp Glu Leu Asp Ser Asp His Asp Phe
355 360 365

Leu Ile Asp Lys Asp Asp Leu Leu Arg Tyr Gly Asn His Ala Leu Thr
370 375 380

Tyr Arg Ile Val Glu Arg Ile Phe Ser Gln Val Pro Arg Lys Phe Thr
385 390 395 400

Ser Lys Val Ala Gly Lys Met Gly Tyr Glu Asp Phe Val Trp Phe Ile
405 410 415

Leu Ser Glu Glu Asp Lys Ser Ser Glu Pro Ser Leu Glu Tyr Trp Phe
420 425 430

Lys Cys Val Asp Leu Asp Cys Asp Gly Met Ile Ile Leu Asn Glu Met
435 440 445

Gln Tyr Phe Tyr Glu Glu Gln Leu His Arg Met Glu Cys Met Ala Gln
450 455 460

Glu Pro Val Leu Phe Glu Asp Ile Val Cys Gln Met Thr Asp Met Ile
465 470 475 480

Gly Pro Ala Asn Glu Gly Arg Leu Thr Leu Arg Asp Leu Lys Arg Cys
485 490 495

Lys Leu Ser Gly Asn Phe Phe Asn Ile Leu Phe Asn Leu Asn Lys Phe
500 505 510

Val Ala Phe Glu Thr Arg Asp Pro Phe Leu Ile Arg Gln Glu Arg Glu
515 520 525

Asp Pro Ser Leu Thr Glu Trp Asp Arg Phe Ala His Ile Glu Tyr Ile
530 535 540

Arg Leu Ser Met Glu Glu Asp Gly Glu Asp Ala Ser Asn Gly Ser Ala
545 550 555 560

Glu Val Trp Asp Glu Pro Gly Tyr Glu Ala Pro Phe
565 570

<210> 12
<211> 532
<212> PRT
<213> Physcomitrella patens

<400> 12
Met Ile Ser Gly Ala Ser Gly Ala Pro Ala Gly Ala Pro Val Pro Thr
1 5 10 15

Ala Thr Gly Ser Val Ala Ala Pro Leu Pro Ala Leu Glu Trp Lys Phe
20 25 30

Ser Gln Val Phe Gly Glu Arg Ala Ile Gly Glu Glu Val Gln Glu Val
35 40 45

Asp Ile Ile Ser Ala Ile Glu Phe Asp Lys Thr Gly Glu His Leu Ala
50 55 60

Thr Gly Asp Arg Gly Gly Arg Val Val Leu Phe Glu Arg Thr Asp Gly
65 70 75 80

Lys Asp Gln Arg Thr Arg Arg Glu Leu Glu Arg Ala Asp Ser Ala Gly
85 90 95

Ser Arg His Pro Glu Tyr Arg Tyr Ser Thr Glu Phe Gln Ser His Glu
100 105 110

Pro Glu Phe Asp Tyr Leu Lys Ser Leu Glu Ile Glu Glu Lys Ile Asn
115 120 125

Lys Ile Arg Trp Cys Gln Thr Ala Asn Ala Ala Gln Phe Leu Ile Ser
130 135 140

Thr Asn Asp Lys Thr Ile Lys Leu Trp Lys Val Thr Glu Lys Lys Val
145 150 155 160

```
Lys Gln Val Lys Asn Leu Asn Val Asp Pro Gly Ala Arg Gly Asn Gly
                165                 170                 175

Asn Pro Leu Ser Asn Asn Met Met Leu Asn Pro Lys Gly Phe Ala Pro
            180                 185                 190

Arg Leu Ser Met Asn Gly Val Ala Ala Asn Arg Ser Thr Pro Ala Ile
        195                 200                 205

Ser Pro Asp Phe Val Phe Pro Pro Gly Gly Ile Pro Ser Leu His Leu
    210                 215                 220

Pro Ser Val Trp Ser Asn Glu Thr Ala Leu Val Ala Arg Cys Arg Arg
225                 230                 235                 240

Ala Tyr Ala Asn Ala His Ala Tyr His Ile Asn Ser Ile Ser Asn Asn
                245                 250                 255

Ser Asp Cys Glu Thr Tyr Ile Ser Ala Asp Asp Leu Arg Ile Asn Leu
            260                 265                 270

Trp Asn Leu Glu Val Ser Asp Gln Ser Phe Asn Ile Val Asp Ile Lys
        275                 280                 285

Pro Thr Asn Met Glu Asp Leu Thr Glu Val Ile Thr Ser Ala Glu Phe
    290                 295                 300

His Pro Ser His Cys Asn Val Leu Ala Tyr Ser Ser Ser Lys Gly Ser
305                 310                 315                 320

Ile Arg Leu Ile Asp Met Arg Gln Ser Ala Leu Cys Asp Arg His Ser
                325                 330                 335

Lys Leu Phe Glu Glu Thr Glu His Ala Gly Ser Arg Ser Phe Phe Thr
            340                 345                 350

Glu Ile Ile Ala Ser Ile Ser Asp Ile Lys Phe Ala Arg Gly Gly Arg
        355                 360                 365

Tyr Ile Leu Ser Arg Asp Tyr Met Thr Leu Lys Leu Trp Asp Val Asn
    370                 375                 380

Met Glu Ser Ser Pro Val Ala Val Phe Lys Val His Glu Tyr Leu Arg
385                 390                 395                 400

Pro Lys Leu Cys Asp Leu Tyr Glu Asn Asp Ser Ile Phe Asp Lys Phe
                405                 410                 415

Glu Cys Cys Leu Ser Gly Asp Gly Met Arg Val Ala Thr Gly Ser Tyr
            420                 425                 430

Ser Asn Leu Phe Arg Val Phe Gly Ala Ala Thr Gly Ser Glu Glu Ala
        435                 440                 445

Ser Thr Leu Glu Ala Ser Lys Thr Pro Asn Arg Arg Ile Val Thr Pro
    450                 455                 460
```

Pro Ser Lys Ala Gly Ser Arg Leu Ala Asn Leu Ala Arg Gly Arg Arg
465   470   475   480

Asp Asn Arg Arg Gly Gly Glu Ser Pro Gly Ile Asp Leu Asn Gly Gly
                485   490   495

Val Gln Asp Phe Thr Ser Lys Leu Leu His Leu Ala Trp His Pro Ala
            500   505   510

Ala Asn Val Ile Ala Phe Ala Leu Ala Arg Cys Ser Leu His Pro Thr
        515   520   525

Ala Cys Thr Cys
    530

<210> 13
<211> 306
<212> PRT
<213> Physcomitrella patens

<400> 13
Met Pro Ser Tyr Ala Asp Val Asp Arg Gln Ile Glu Gln Leu Ser Glu
  1   5   10   15

Cys Lys Pro Leu Ser Glu Leu Glu Val Lys Asn Leu Cys Asp Gln Ala
             20   25   30

Arg Thr Ile Leu Val Glu Glu Trp Asn Val Gln Pro Val Lys Cys Pro
         35   40   45

Val Thr Val Cys Gly Asp Ile His Gly Gln Phe His Asp Leu Ile Glu
     50   55   60

Leu Phe Arg Ile Gly Gly Lys Ala Pro Asp Thr Asn Tyr Leu Phe Met
 65   70   75   80

Gly Asp Tyr Val Asp Arg Gly Tyr Tyr Ser Val Glu Thr Val Ser Leu
                 85   90   95

Leu Val Ala Leu Lys Val Arg Tyr Arg Asp Arg Ile Thr Ile Leu Arg
            100   105   110

Gly Asn His Glu Ser Arg Gln Ile Thr Gln Val Tyr Gly Phe Tyr Asp
        115   120   125

Glu Cys Leu Arg Lys Tyr Gly Asn Ala Asn Val Trp Lys Tyr Phe Thr
    130   135   140

Asp Leu Phe Asp Tyr Leu Pro Leu Thr Ala Leu Ile Glu His Glu Ile
145   150   155   160

Phe Cys Leu His Gly Gly Leu Ser Pro Ser Leu Asp Thr Leu Asp His
                165   170   175

Ile Arg Ala Leu Asp Arg Ile Gln Glu Val Pro His Glu Gly Pro Met
            180   185   190

Cys Asp Leu Leu Trp Ser Asp Pro Asp Asp Arg Cys Gly Trp Gly Ile
195 200 205

Ser Pro Arg Gly Ala Gly Tyr Thr Phe Gly Gln Asp Ile Ala Glu Gln
210 215 220

Phe Asn His Thr Asn Gly Leu Ser Leu Val Ala Arg Ala His Gln Leu
225 230 235 240

Val Met Glu Gly Tyr Asn Trp Cys Gln Asp Lys Asn Val Val Thr Val
245 250 255

Phe Ser Ala Pro Asn Tyr Cys Tyr Arg Cys Gly Asn Met Ala Ala Ile
260 265 270

Met Glu Ile Asp Glu Thr Met Asn Arg Ser Phe Leu Gln Phe Glu Pro
275 280 285

Ala Pro Arg Gln Ser Glu Pro Asp Val Thr Arg Lys Thr Pro Asp Tyr
290 295 300

Phe Leu
305

<210> 14
<211> 353
<212> PRT
<213> Physcomitrella patens

<400> 14
Met Gly Ile Tyr Leu Cys Ser Pro Lys Thr Asp Lys Thr Ser Glu Asp
1 5 10 15

Asp Glu Asn Ala Glu Leu Arg Tyr Gly Leu Ser Ala Met Gln Gly Trp
20 25 30

Arg Asp Ser Met Glu Asp Ala His Lys Ala Ile Leu Asn Val Asp Lys
35 40 45

Asn Thr Ser Thr Ser Ile Phe Gly Ile Phe Asp Gly His Gly Gly Lys
50 55 60

Leu Val Ala Lys Phe Cys Ala Lys His Leu His Gln Glu Val Leu Lys
65 70 75 80

Ser Glu Ala Tyr Ala Lys Gly Asp Leu Lys Ala Ser Leu Glu Tyr Ser
85 90 95

Phe Leu Arg Met Asp Glu Met Met Lys Gly Ala Ser Gly Trp Lys Glu
100 105 110

Leu Gln Ser Leu Glu Glu Thr Ser Ser Gln Leu Asp Lys Leu Gly Asn
115 120 125

Gly Asn Ser Ser Ser Asn Ala Arg Glu Asp Asp Glu Ser Asp Tyr Ser
130 135 140

Tyr Ala Val Leu Thr Glu Ser Asn Asp Ser Asn Leu Ala Thr Lys Lys
145 150 155 160

His Lys Tyr Ser Asp Phe Gln Gly Pro Ile Tyr Gly Ser Thr Ala Val
165 170 175

Val Ala Leu Ile Arg Gly Asn Lys Leu Phe Val Ala Asn Ala Gly Asp
180 185 190

Ser Arg Cys Ile Met Ser Arg Arg Gly Glu Ala Val Asn Leu Ser Ile
195 200 205

Asp His Lys Pro Asn Leu Glu His Glu Arg Lys Arg Ile Glu Ser Ala
210 215 220

Gly Gly Phe Val His Gly Gly Arg Val Asn Gly Ser Leu Asn Leu Thr
225 230 235 240

Arg Ala Ile Gly Asp Met Glu Phe Lys Gly Arg Pro Asp Leu Pro Pro
245 250 255

Asp Lys Gln Val Val Thr Cys Cys Pro Asp Val Val Glu Val Asp Leu
260 265 270

Gly Pro Gly Asp Glu Phe Ile Val Leu Ala Cys Asp Gly Ile Trp Asp
275 280 285

Val Met Ser Ser Gln Ala Val Val Asp Phe Val Lys Ser Arg Leu Pro
290 295 300

Thr Thr Lys Thr Leu Ser Ser Leu Cys Glu Glu Ile Leu Asp Tyr Cys
305 310 315 320

Leu Ser Pro Thr Thr Arg Gln Gln Glu Gly Cys Asp Asn Met Ser Ile
325 330 335

Ile Ile Val Gln Pro Lys Gln Ser Gly Val Ala Ala Ser Ser Ser Thr
340 345 350

Asp

<210> 15
<211> 371
<212> PRT
<213> Physcomitrella patens

<400> 15
Met Val Glu Trp Val Met Lys Met Leu Met Ala Cys Trp Arg Pro Val
1 5 10 15

Gln Lys Tyr Thr His Leu Gly Glu Glu Asn Gly Asp Asn His Asp Pro
20 25 30

Leu Leu Trp His Lys Asp Leu Gly Asp His Ala Ala Gly Gln Phe Ser
35 40 45

Ile Ala Ala Val Gln Ala Asn Ala Ile Leu Glu Asp Met Val Gln Val
50 55 60

Glu Thr Gly Pro Phe Gly Thr Phe Val Gly Val Tyr Asp Gly His Gly
65 70 75 80

Gly Pro Glu Ala Ser Arg Tyr Val Asn Asp Ser Leu Tyr Arg His Leu
85 90 95

Gln Lys Phe Ala Thr Gln His Gly Gly Met Ser Ser Glu Val Leu Gln
100 105 110

Gln Ala Phe Lys Gln Thr Glu Glu Gly Phe Leu Glu Ile Val Arg Asp
115 120 125

Ser Trp Leu Thr Lys Pro Gln Ile Ala Ala Val Gly Ser Cys Cys Leu
130 135 140

Val Gly Val Val Trp Glu Cys Lys Leu Tyr Ile Ala Ser Leu Gly Asp
145 150 155 160

Ser Lys Ala Val Leu Gly Arg Phe Ser Arg Asn Leu Gln Ser Val Ile
165 170 175

Ala Thr Glu Ile Ser Thr Glu His Asn Ala Ser Val Glu Ala Val Arg
180 185 190

Gln Asp Leu Gln Ala Ala His Pro Asp Asp Pro Arg Ile Val Val Leu
195 200 205

Arg His Gly Val Trp Arg Val Lys Gly Leu Ile Gln Val Ser Arg Ser
210 215 220

Ile Gly Asp Val Tyr Leu Lys Lys Ala Glu Phe Asn Arg Glu Pro Leu
225 230 235 240

Ile Gly Arg Phe Arg Leu Pro Glu Pro Leu Gln Arg Pro Val Met Ser
245 250 255

Ala Glu Pro Asp Ile Arg Val Ile Asp Leu Thr Pro Asp Val Glu Phe
260 265 270

Val Ile Phe Ala Ser Asp Gly Leu Trp Glu His Leu Ser Asn Gln Glu
275 280 285

Ala Val Asp Ile Val His Lys Tyr Pro Arg Ala Gly Ile Ala Arg Gln
290 295 300

Leu Ile Arg Tyr Ala Leu His Glu Ala Ala Lys Lys Arg Glu Met Arg
305 310 315 320

Tyr Ser Asp Leu Lys Lys Ile Glu Arg Gly Ile Arg Arg His Phe His
325 330 335

Asp Asp Ile Thr Val Val Val Val Phe Leu Asp His Asn Leu Val Ser
340 345 350

Asn Gly Ser Gly Ile Ser His His Ile Ser Val Lys Gly Gly Val Asp
355 360 365

Lys Pro Ser
370

<210> 16
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 16
caggaaacag ctatgacc 18

<210> 17
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 17
ctaaagggaa caaaagctg 19

<210> 18
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 18
tgtaaaacga cggccagt 18

<210> 19
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 19
ctgccgttgg aggcatcctc gccatc 26

<210> 20
<211> 34
<212> DNA

<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 20
atcccgggca tcgggaagac ggtgtgtgtg tgtg 34

<210> 21
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 21
gcgttaacgc taccagcctc gggctgaacc agtc 34

<210> 22
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 22
ggagcccttg ctgctactgt atgct 25

<210> 23
<211> 32
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 23
atcccgggtg gtggtggcgg tgaagttatt ac 32

<210> 24
<211> 31
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 24
gcgttaacat gtacaagctg ttggatgcag c 31

<210> 25

<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 25
acatcgggcc ctcgtgcggc acttc 25

<210> 26
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 26
gcgttaacgc gcggaggaga gcggatcggt tag 33

<210> 27
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 27
gcgagctcga gcatgccata tacagtaggt gtg 33

<210> 28
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 28
gcgatatcga tttgcaaggg cgaagtgcac aaga 34

<210> 29
<211> 32
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 29
gcgatatcga aggcagaagg caactcccag tt 32

<210> 30
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 30
cactcccaca ccacacctac caggca 26

<210> 31
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 31
gggcttcgtg agccatgaat ccctt 25

<210> 32
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 32
atcccgggcg tggaaggaga ggcgaatgtg gagg 34

<210> 33
<211> 32
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 33
gcgagctcct gtgggtgtct agcttcaggt tc 32

<210> 34
<211> 30
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 34

gcgctgcaga tttcatttgg agaggacacg 30

<210> 35
<211> 35
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 35
cgcggccggc ctcagaagaa ctcgtcaaga aggcg 35

<210> 36
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 36
gctgacacgc caagcctcgc tagtc 25

<210> 37
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 37
gcagacgtat gggaactagc cacct 25

<210> 38
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 38
cgctctacga ttcggtaggt gagagc 26

<210> 39
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 39
ctggcgacag aggaggacgc gttgt 25

<210> 40
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 40
gcgtaggctc ttctacatct cgcaac 26

<210> 41
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 41
cggacgatct tggtggagga gtggaac 27

<210> 42
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 42
gtgtcgagcg atggagacag accac 25

<210> 43
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 43
cggatggatg agatgatgaa gggag 25

<210> 44
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 44
cacgaccacc atggacgaag cctcca 26

<210> 45
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 45
ggctgtgctc ggtagattct ctcgca 26

<210> 46
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 46
cagcctcttg gttggacaag tgctc 25